

PDEIS-5. “Descriptions of Mass-Wasting Mapping Units.”

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MWMU 1A - Ancient and Dormant Slump-Earthflow Topography**Terrain Characteristics**

MWMU 1A consists of subdued topography. Most slopes are inclined at from 20 to 30 percent, locally steeper. Slopes consist of broad upland areas, and gentle, hummocky midslope benches, separated by rises (scarps).

Slope Movement Processes (Mass Wasting)

There is no historical slope movement or active slope movement occurring in MWMU 1A. This unit consists of the bodies of large dormant and ancient landslide complexes, which incorporate smaller landslides within the main landslide masses. Past slope movement has consisted of block glide and slump-earthflow processes in deeply weathered and pervasively fractured phyllite and, locally, to the north in the Chuckanut sedimentary strata.

Erosion

Surface erosion is limited to sites where the forest duff has been removed along landslide scarps, roads, and log skid trails.

Key Elements Affecting Slope Processes**Terrain and Climatic Effects**

Key elements affecting slope movement processes within MWMU 1A are slope inclination and ground water levels. New slope movements, if they were to occur, would be triggered at the lower ends of landslide features by erosional undercutting at the toe, during an intense rainstorm of long duration or a rain-on-snow event. A strong earthquake could potentially trigger slope movement within these features if ground water levels were sufficiently high.

Human-Caused Effects

Slope movement processes could be affected by earthwork and drainage modifications along forest roads. Road cut excavations and fills could alter the mechanical relationships on landslide blocks. Road cuts would remove support from slope movement features, possibly causing internal adjustments to occur. Cuts in landslide debris steeper than 1.5H:1V (horizontal:vertical) would likely lead to at least localized slope movement. Fills constructed along the upper ends of landslide blocks could increase driving forces. Concentration of water on landslide blocks could increase hydrostatic pressures and affect slope processes.

Root structures left in stumps after timber harvest activities would, over time, decompose, and there would be a reduced root structural capacity to hold near-surface soils in place, to the degree that the soil strength loss is not replaced by roots of new vegetation. This could result in small-scale debris flows and surface erosion on steep slopes, primarily the local headscarps of small landslide features within the MWMU, where mineral soil is exposed. Because of the relatively gentle terrain in most locations, there is a low probability that soil from this MWMU would be delivered to public resources. For that reason, MWMU 1A has been given a low potential hazard rating for forest practice activities.

MWMU 1B (ARS 1): Headscarps and Toes of Ancient and Dormant Deep-Seated Landslides

Terrain Characteristics

MWMU 1B consists of relatively steep topography at the headscarps and toes of large landslide complexes. Slope inclinations of headscarps range from approximately 80 to 100 percent, with most about 90 percent. Slope inclinations along the toes of these features are greater than 20 percent, and generally 60 to 70 percent.

Slope Movement Processes (Mass Wasting)

Historic slope movement has not occurred, except in isolated locations within this MWMU. Historic features consist of local debris slides and detached blocks of rock along headscarps.

Erosion

Surface erosion has been, and in the future would be, limited to sites where the forest duff has been removed along landslide scarps, roads, and log skid trails.

Key Elements Affecting Slope Processes

Terrain and Climatic Effects

Key elements affecting slope movement processes within MWMU 1B are slope inclination, and localized concentrations of ground water. New slope movements, if they were to occur, would be triggered at the lower ends of landslide features by erosional undercutting at the toe, during an intense rainstorm of long duration or a rain-on-snow event. Slope movement along headscarps would most likely be caused by local concentrations of water. If movement was initiated in a landslide block (MWMU 1A) by events downslope, changes in slope height and inclination along the affected headscarp could cause movement to occur along the headscarp. Movement would likely consist of block glide, slumping, debris slides, or, potentially, debris flows.

Human-Caused Effects

Slope movement processes could be affected by earthwork and drainage modifications along forest roads in MWMU 1B. Road cut excavations alter the mechanical relationships on steep slopes by removing support. Conversely, a fill constructed along the toe of a landslide block could either increase the forces resisting slope movement or increase driving forces, depending on how it was positioned in relation to the overall slope geometry. Concentration of water on landslide blocks could locally increase hydrostatic pressures and affect slope processes.

Root structures left in stumps after timber harvest activities would, over time, decompose, and there would be a reduced root structural capacity to hold near-surface soils in place, to the degree that the soil strength loss is not replaced by roots of new vegetation. This could result in small-scale debris flows and surface erosion on steep slopes within the MWMU, particularly where mineral soil is exposed.

Most of the headscarps are situated sufficiently high on the slopes that debris flows initiated there would not likely deliver sediment to public resources. Conversely, most of the toes of the large, deep-seated features are located along streams. If debris flows were initiated in these toe areas, the potential for delivery from these locations is high. For these reasons, MWMU 1B has been given a moderate potential hazard rating for forest practice activities. For planning purposes, ARS 1 has been given a stability designation of “unstable.”

MWMU 1C (ARS 2): Incised Stream Channels Within Deep-Seated Landslides**Terrain Characteristics**

MWMU 1C consists of the banks and adjacent sideslopes of steep gradient, incised stream channels that drain ancient, deep-seated slope movement features. Most of these channels are located on the southwest slopes of Stewart Mountain and on the northern and northwestern slopes of Anderson Mountain. Channels are eroded in landslide debris. Slope inclinations along the channel walls are greater than 50 percent, in most cases between 70 and 90 percent. Channel walls are 10 feet or greater in height. The alluvial fans at the mouths of the stream channels are included in MWMU 3.

Slope Movement Processes (Mass Wasting)

Historic slope movement in this MWMU consists of small, shallow slumps and debris flows. The debris flows initiated along the channel walls, and extended downstream from source locations to fans at the mouths of channels, and into public facilities.

Erosion

Surface erosion has been and, in the future, likely would be limited to sites where the forest duff has been removed along landslide scarps, roads, log skid trails, and along the active stream channels.

Key Elements Affecting Slope Processes**Terrain and Climatic Effects**

Key elements affecting slope movement processes within MWMU 1C are slope inclinations greater than 70 percent, and increased ground water pore and hydrostatic pressures, generally during intense rainstorms of long duration or rain-on-snow events. Bends and irregularities in the stream channels are points of impact from which additional debris is removed during flow events, increasing the volume of flowing materials.

Human-Caused Effects

Slope movement processes could be affected by earthwork and drainage modifications along forest roads in MWMU 1C. Road cut excavations on slopes greater than 70 percent would likely initiate slope movement by removing support. Existing fills within these channels could be overtopped and removed by debris flows initiated up-gradient, increasing the volume of the flow. Concentration of water on landslide blocks could locally increase hydrostatic pressures and affect slope processes, which, in turn, could trigger debris flows affecting the down-gradient segments of entire stream systems.

Root structures left in stumps after timber harvest activities would, over time, decompose, and there would be a reduced root structural capacity to hold near-surface soils in place, to the degree that the soil strength loss is not replaced by roots of new vegetation. The degree to which the root strength loss is not replaced by new vegetation could result in small-scale debris flows and surface erosion on steep slopes within the MWMU, particularly where mineral soil is exposed.

Historic debris flows along these channels have flowed directly into public resources. For this reason, MWMU 1C has been given a high potential hazard rating for forest practice activities. For planning purposes, ARS 2 is designated “unstable.”

MWMU 2 (ARS 3): Incised Stream Channels and Associated Landforms Within Darrington Phyllite

Terrain Characteristics

MWMU 2 includes the channels through which flow Blue Canyon, its tributaries, and South Creek. Terrain within these channels consist of deeply-incised stream channels (inner gorges) and headwall areas having

slope inclinations steeper than 70 percent, and slopes above the incised channels inclined steeper than 50 percent. Present along the various slopes are local slope movement features in soil that are generally inclined steeper than 40 percent, but may have locally flatter slopes as gentle as 20 percent. Slopes within this MWMU are complex. Soils within these drainages generally consist of fine grained mica platelets with sand and rock fragments, and are shallow, from inches to as much as four feet deep. Soils are underlain by deeply-weathered and pervasively-fractured phyllite. The alluvial fan at the mouths of Blue Canyon and South Creek are included in MWMU 3.

Slope Movement Processes (Mass Wasting)

Historic slope movement in this MWMU consists of debris avalanches, debris flows, and dam-break floods. Small, local block glide features also are present within the MWMU. The debris flows have initiated at various slope movement features and other locations along the channel walls and floor, and migrated downstream from the source location to a fan in Lake Whatcom.

Erosion

Surface erosion is limited to sites where the forest duff has been removed along landslide scarps, and along the active stream channels.

Key Elements Affecting Slope Processes

Terrain and Climatic Effects

Key elements affecting slope movement processes within MWMU 2 are slope inclinations greater than 70 percent, and increased ground water pore and hydrostatic pressures, generally during intense rainstorms of long duration or rain-on-snow events. Bends, irregularities and debris jams along the stream channels are points of impact from which additional debris is removed during flow events, increasing the volume of flowing materials.

Human-Caused Effects

Slope movement processes would likely be affected if roads were constructed in MWMU 2. Road cut excavations on slopes greater than 70 percent would likely initiate slope movement in soil and weathered rock by removing support. Concentration of water on soils on steep slopes could locally increase hydrostatic pressures and affect slope processes, which, in turn, could trigger debris flows that would affect the down-gradient segments of an entire stream system.

Root structures left in stumps after timber harvest activities would, over time, decompose, and there would be a reduced root structural capacity to hold near-surface soils in place, to the degree that the soil strength loss is not replaced by roots of new vegetation. This could

result in small-scale debris flows, and would increase surface erosion on slopes within the MWMU, particularly where mineral soil is exposed.

Historic debris flows along these channels have flowed directly into public resources and Lake Whatcom. For this reason, MWMU 2 has been given a high potential hazard rating for forest practice activities. For planning purposes, ARS 3 is designated as “unstable.”

MWMU 3: Stable Slopes, Ridgecrests, and Valley Floors

Terrain Characteristics

MWMU 3 includes slopes of all forms and inclinations with no history of slope movement processes, and having a low likelihood of sediment delivery to anadromous fisheries if slope movement did occur. Landforms include ridge crests; erosional benches; small, stable drainages eroded in rock; alluvial fans; low-gradient valley floors; and flood plains. MWMU 3 is underlain by Chuckanut sedimentary strata, sandy soils derived from these strata, glacially-derived sediments, and alluvial and fluvial deposits.

For planning purposes, all slopes greater than 70 percent within this MWMU have been given a designation of “potentially unstable slopes” (refer to Potentially Unstable Slopes below).

Slope Movement Processes (Mass Wasting)

No slope movement features were noted in this MWMU, with the exception of debris flow deposits in fans at the mouths of streams around Lake Whatcom.

Erosion

Surface erosion is limited to sites where the forest duff has been removed along steeper slope segments and roads, and along the active stream channels.

Key Elements Affecting Slope Processes

Terrain and Climatic Effects

Key elements affecting slope movement processes within MWMU 3 are slope inclinations greater than 70 percent, and increased ground water pore and hydrostatic pressures, generally during intense rainstorms of long duration or rain-on-snow events.

Human-Caused Effects

Slope movement processes could be triggered if cut slopes steeper than 1.5H:1V were constructed in soil, or from local concentration of water on soils on steep slopes.

Root structures left in stumps after timber harvest activities would, over time, decompose, and there would be a reduced root structural capacity to hold near-surface soils in place, to the degree that the soil strength loss is not replaced by roots of new vegetation. This could result in increased surface erosion on slopes within the MWMU where mineral soil is exposed.

Impacts from slope movement and erosion in this MWMU have been minimal. For this reason, MWMU 2 has been given a low potential hazard rating for forest practice activities. Slopes greater than 70 percent have been designated “potentially unstable” for planning purposes (see Potentially Unstable Slopes below). Since the alluvial fans in MWMU 3 are runout areas for processes occurring in MWMUs 1B, 1C, and 4, and are potentially hazardous, they should be considered high hazard areas. As stated above, the alluvial fans are considered a critical area in the Whatcom County Critical Areas Ordinance, Title 16, Section 16.16.340.

MWMU 4 (ARS 4): Incised Stream Channels and Associated Landforms Within Chuckanut Formation

Terrain Characteristics

MWMU 4 includes deep, steep-walled channels incised in Chuckanut sedimentary strata, primarily the Bellingham Bay Member, and steep shoreline segments along Lake Whatcom. The upper reaches of Blue Canyon are included in this MWMU. The deeply-incised stream channels (inner gorges) and headwall areas have slope inclinations steeper than 70 percent (sometimes greater than 100 percent). Continuous slopes above the incised channels, and slopes along the Lake Whatcom shoreline inclined at 50 percent or greater are included in MWMU 4. Slopes immediately adjacent to the mapped boundaries of MWMU 4 having inclinations of 70 percent or greater are mapped as “potentially unstable” (refer to Potentially Unstable Slopes below).

Slopes within this MWMU are planar to concave, and locally complex. Soils within these drainages generally consist of sand, and are generally shallow (from inches to as much as four feet deep) except in local concave headwall areas, where depths are greater. The alluvial fans at the mouths of various channels along the shores of Lake Whatcom, and Reed and Cain Lakes are included in MWMU 3.

Slope Movement Processes (Mass Wasting)

Historic slope movement in this MWMU consists of debris avalanches, debris flows, and dam-break floods. Small, local block glide features in rock and soil are also present within the MWMU. The debris flows have initiated at various slope movement processes along the channel walls and

floor, and migrated downstream from the source location to fans along the shorelines of Lake Whatcom, and Reed and Cain Lakes.

Erosion

Surface erosion is limited to sites where the forest duff has been removed along road cuts and fills, logging skid trails, landslide scarps, and along the active stream channels.

Key Elements Affecting Slope Processes**Terrain and Climatic Effects**

Key elements affecting slope movement processes within MWMU 4 are slope inclinations greater than 70 percent, and increased ground water pore and hydrostatic pressures, generally during intense rainstorms of long duration or rain-on-snow events. Bends, irregularities and debris jams along the stream channels are points of impact from which additional debris is removed during flow events, increasing the volume of flowing materials.

Human-Caused Effects

Slope movement processes have been significantly affected by existing roads in MWMU 4. Over-steepened cut and fill slopes, inadequate drainage, and poor maintenance practices have produced a combination of conditions that have initiated slope movement processes within and adjacent to road prisms. Large fills constructed across steep, unstable stream channels have contributed significant volumes of soil and debris to in-stream processes, and, along with numerous sidecast fills, been the initiation points of large debris slides and, ultimately, flows within the MWMU. Even though new roads proposed for MWMU 4 would be constructed full-bench, instability along cut slopes and at points of local concentration of stormwater runoff would still be likely.

Piles of logging debris and slash were left in headwall areas and first order (Type 5 and 4) streams by past logging operations. Much of this debris was incorporated into destructive debris flows, and some subsequent debris dams were incorporated into destructive debris flows in steep, tightly-confined channels.

Root structures left in stumps after timber harvest activities would, over time, decompose, and there would be a reduced root structural capacity to hold near-surface soils in place, to the degree that the soil strength loss is not replaced by roots of new vegetation. This could result in small-scale debris flows, and would increase surface erosion on slopes within the MWMU, particularly where mineral soil is exposed.

Historic debris flows along these channels have flowed directly onto and through alluvial fans along Reed and Cain Lakes, and Lake Whatcom, which are fish habitat and potable water sources. Slopes within this MWMU are inherently unstable, and slope instability has been, and, in the future, would be exacerbated by forest practice activities. For this reason, MWMU 4 has been given a high potential hazard rating for forest practice activities. ARS 4 has been designated “unstable” for planning purposes.